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ABSTRACT

The Investigation into Information Requirements of the Social Sciences (INFROSS) was initiated in 1968 because it was feared that in the absence of knowledge about information requirements of the social sciences, solutions adopted in science, based on the findings of science user studies, would be applied to the social sciences. It is now desirable that the results of INFROSS should be compared with those of science user studies. To do this it is essential that studies should be based on comparable data. The relationship between the sciences and the characteristics of each science must be taken into account in ascertaining the differing information requirements of scientists and social scientists. This report therefore attempts to draw from science user studies possible general conclusions that enable a comparison to be made with the results of INFROSS, and in doing so considers some of the methodological problems involved. (Related reports are LI004402 and 004403.) (Author/SJ)

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Design of Information Systems in the Social Sciences

Working Paper No. 1

COMPARISON OF RESULTS OF SCIENCE USER STUDIES WITH "INVESTIGATION INTO INFORMATION REQUIREMENTS OF THE SOCIAL SCIENCES"

Barbara Skelton

July, 1971

LI 004 401

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1.0 Introduction

The information seeking behaviour of scientists has been under investigation for the past 20 years, whilst that of social scientists has only recently been studied seriously. One of the reasons why the Investigation into Information Requirements of the Social Sciences (INFROSS) was initiated in 1968 was the fear that in the absence of knowledge about information requirements of the social sciences, solutions adopted in science, based on the findings of science user studies, would be applied to the social sciences. This investigation was completed at the end of 1970, and it is now desirable that the results of INFROSS should be compared with those of science user studies.

In order to avoid the problems created by the haphazard development of science user studies, the INFROSS survey was on a national scale and sought to be as comprehensive as possible in obtaining data on information requirements of social scientists in various environments. Science user studies have often been restricted to obtaining data on very localised situations. The literature of science user studies is composed of a large body of data that cannot be correlated, due to differing objectives, methodologies, samples, scales and definitions used by the studies. Each study stands in isolation, with no obvious links that enable it to be compared with other studies. For the purpose of comparing the results of science user studies and INFROSS it is essential that studies should be based on comparable data. This report therefore attempts to draw from science user studies possible general conclusions that enable a comparison to be made with the results of INFROSS, and in doing so will consider some of the methodological problems involved. Not all the areas on which INFROSS obtained data are considered in the comparison, because in many instances the data obtained from social scientists may not have been obtained from scientists (and vice versa). Social sciences are still developing disciplines; many of them have been firmly established only since the beginning of this century, whereas the physical sciences go back several centuries. The relationship between the sciences and the characteristics of each science must be taken into account in ascertaining the differing information requirements of scientists and social scientists.

Two main issues are involved in the comparison of results of user studies: a) techniques and methodology employed in the studies, and b) the conceptual nature of the studies.

Techniques and methodology vary tremendously; details related to specific studies are dealt with in section 4. At this point it is necessary only to emphasise the importance of method, for on it depend not only the quality of results, but also the whole validity of the study. As much effort should be directed towards the methodology as to the actual manipulation of the data. It is essential that when the results of a study are reported the methodology is fully documented, for the value of results can only be assessed when the methodology is made clear.

To clarify the conceptual aspects of the study, a report should include a definition of aims and objectives, and specify the environment in which the study is carried out. The full background of the sample population must be known, in addition to any economic or social factors that may affect the user. A viable comparison of results can only be made when the full circumstances of the study are presented. A study that relates to a small group of users in a specialised environment cannot be assumed to be comparable with a more general and far-reaching study.

There appear to be two main types of study: (a) studies to explore the flow of information within a given environment, and (b) studies to seek data on the operation of specific services, e.g. an SDI service. The practical implications of each type of study vary, and this may partly account for the lack of any cohesive patterns within user studies. Paisley (1968) states in his review of user studies the need for a 'middle-range hypothesis' to give a structure to the studies. A theoretical concept is required that links user data and systems theory in a manner that is practical and clear. At the moment the study of information needs is still in its 'typology phase': the generalizations and broad concepts require more precise definition in order to allow efficient information systems design.

2.0 The relationship between the sciences

It is essential to take into account the relationship between the sciences when comparing the results of science and social science user studies, for it is the basic characteristics of the sciences that determine the type of scientific data available. Information system design should be such as to accommodate different types of data, and make it available, as far as possible, according to user requirements.

2.1 The characteristics of the sciences

Kuhn (1962) identifies three kinds of scientific activity: pre-normal, normal and applied. Pre-normal science is characterized by no agreement on methods and procedures for conducting an enquiry, whereas normal science is characterized by a consensus regarding paradigms. Physics and chemistry may be considered as normal sciences, sociology and political science as pre-normal sciences, and engineering as applied. The social sciences are in a pre-paradigmatic stage of development, and advancement of knowledge in these fields is made by trial and error. The information requirements of such a discipline are difficult to assess, for the content of social science material is constantly changing at varying rates. The advancement of knowledge in this area is upset by constant side-tracking, which an efficient information system must be able to handle.

Storer (1967) categorizes sciences according to their hardness and softness: he relates the degree of rigour of a discipline to the extent to which mathematics is used, the harder sciences being characterized by greater use of mathematics. Pantin (1959) also uses mathematics as a means of classifying sciences, and identifies restricted and unrestricted sciences; the more a science is restricted in the classes of its objects, the more probable it is that far-reaching mathematical hypotheses can be set up which can be tested by precise measurement. Guttsman (1966) describes the physical sciences as requiring evaluation of results of experimentalism, while in the social sciences subjective judgements play a major part in evaluation.

The implications of the characteristics of sciences on information systems are great. For example, users of physical science material may be specific in their approach to seeking information, whereas the social

scientist may prefer a system that allows non-specificity of requests, for browsing and serendipity play an important role in information gathering.

Garvey, Lin & Nelson (1970) conducted a study comparing communication activities in the physical and social sciences. They conclude that the communication systems within each group have similar structures, and that each system is composed of similar elements; the major differences involve the ways in which these elements operate or are functionally related. For instance, when authors submitted manuscripts to publishing journals, each stage of the process, from inception of work to publication, was usually shortest for the physical sciences. The major lag was associated with the conduct of the work. When the material presented at national meetings was traced to publication in journals, it was found that after a year over a third of the science papers presented at meetings had been published, compared with only a sixth of social science papers. This implies that the basic characteristics of scientific work influence patterns of communication.

2.2 The material of the sciences

The scientist's main source of information is archival collections of serial publications, plus unpublished reports, informal contacts and information concerning apparatus availability. The serial paper is the means whereby a scientist may establish his own results and learn of results of others. Social scientists have a much wider range of sources from which to obtain data; for example, court records, tax returns, housing and rates records, birth and death records. Serial publications, although very important, are not the only source of data. Psychology, however, tends to be rather similar to science disciplines, as experimentation forms an important part of the discipline, and serial publications are the main method of disseminating results.

3.0 Comparison of science user studies

Thirteen science user studies have been selected for comparison. The studies have been chosen on the grounds that they obtained data on some of the areas covered by INFROSS, and data collection and presentation were in a form that made comparison possible. Another factor in selection was breadth of coverage, though there is no single science user study as comprehensive as INFROSS in obtaining data on the information seeking behaviour of scientists in different environments. It can be seen from Table 1 that some studies were concerned with only a few aspects of information seeking behaviour. For example, Martyn (1964) limited his study to literature searching, and Hutchins, Pargeter & Saunders (1971) investigated in depth the use of foreign language materials within an academic community. It is hoped that the thirteen science user studies give a reasonably adequate representation of the science user in all environments.

There have been several attempts to compare science user studies in the hope of drawing a generalized profile of the science user. As will be seen, none has been particularly successful.

Menzel (1960), under the auspices of the Bureau of Applied Social Research at Columbia University, attempted a comparison of science user studies. For a particular topic he placed data from each study in tabular form, but made no attempt to present the data in common units, with the result that comparison is not feasible, and his tabulations indicate only the non-comparability of data from user studies. Paisley (1965) first attempted to review the studies of the flow of behavioural science information, but found that none then existed; he reviewed data relating to physical scientists. Little attempt was made to compare results and each study was considered in isolation. Barnes (1965) examined the results of the surveys by the NLL (1963), ACSP* (1963), Fishenden (1958), Martyn (1963) and himself at AERE in 1963, and showed that differences in principle and method made it impossible to demonstrate close agreement of results. Barnes avoided the problem of differing units of measurement by ranking the results of the studies, and so avoided giving absolute figures. Similarly Barber (1966), in a comparison of scientists' use of the library, ranked user preferences when absolute figures were not available.

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It therefore appears that a practical picture of a typical science user has not yet been constructed from the literature on science user studies. It is hoped that by using a selection of science user studies for comparison with INFROSS, generalized profiles of a science user and a social science user may emerge.

4.0 Problems encountered in the comparison of user studies

Two basic types of problem arise: with studies that contain factors that are simply not comparable; and with studies that are comparable but of low validity, of poor quality or otherwise inadequate. The population and environment of a user study create problems that fall into the former category, while sample selection and size, response rate, methodology, statistical techniques and analysis of data fall into the latter category.

4.1 Objectives of user studies

The primary objective of user studies is to provide data for systems design. Other data needed for systems design are bibliometric data and cost data. Data on user requirements must be in a quantitative form, and must be representative of substantial areas of user behaviour to allow implementation in information systems. The fact that there are so many science user studies, giving a variety of results, mitigates against the incorporation of user requirements into the design of an information system serving scientists from a wide variety of environments. Most science user studies can be implemented only in systems designed to serve scientists in a limited environment. Paisley (1965) states that the reasons why there are so many user studies are (a) distrust of previous findings; and (b) the conviction that scientists in a particular environment are unique in their information seeking behaviour.

Science user studies fall into two main categories: those that study information requirements of particular disciplines, and those that study information requirements of scientists within particular environments. Cutting across this two-fold division are the conceptual formulations on which studies are based. A study may be purely exploratory, to formulate hypotheses which may be tested in subsequent studies; for example, the studies by Glass & Norwood (1959) and Menzel (1958). Results from such exploratory studies are not amenable to much depth of analysis, when compared with more detailed studies. Some studies set out to test specific hypotheses, still others study a particular service with a view to improvement. Slater (1967) conducted a survey of current awareness methods used by physicists, the results of which initiated the publication of Current Papers in Physics. However, such studies are aimed at a very small field of information

requirements, and for the purpose of comparison with INFROSS yield little usable data. Fishenden (1959) provides an example of a study which sought data on the efficiency of information retrieval in one particular environment - the Atomic Energy Research Establishment at Harwell. Scott (1959) restricted his study to the environment of the electrical and electronics industry. On the other hand, the Flowers study (1965) was concerned with scientific research in the whole of the UK.

It often appears that when data have been obtained on various aspects of information needs and uses, little effort is directed to interpreting the data in terms of systems design. The results of user studies must be capable of synthesis and accumulation. It is not practical to have information systems tailor-made to individual needs, but a compromise must be found whereby the idiosyncrasies of each scientist within a limited environment can be accommodated by one information system. Flexibility is an essential feature in information system design.

4.2 The population

The population of the study must be adequately defined so that precise comparisons can be made between studies. Disciplines may influence information seeking behaviour. It is difficult to compare studies that deal with specific disciplines (Flowers 1965, Urquhart 1965) with those that have populations taken from various undefined disciplines; Herner (1954) defines his population merely as pure and applied scientists.

4.3 Environment of the study

The environment may play an important part in information seeking behaviour and must therefore be clearly stated; for example, personnel within an industrial environment may differ considerably from those in an academic environment, since the time schedules and work loads are governed by different criteria, and the type of research conducted may be quite different. Martyn (1964) shows how the environment influences scientists in their literature seeking habits, by providing analyses for scientists engaged in industrial research, academic research and research in government laboratories. Local or temporal conditions may also affect the comparability of studies. In the study by Menzel (1958) he points out that the scientists studied were in an atypical situation by belonging to a particular prominent

research institution with unusually good access to other prominent personnel within similar fields, both nationally and internationally.

4.4. Sample selection, size and response rate

Sample selection is critical to the validity of the study, and it is essential to note when comparing studies whether the sample is representative, both in size and structure, of the population as a whole. In most studies it appears that the sample is randomly selected, and in some, e.g Hogg & Smith (1959) and Herner (1954), a random sample is stratified by status grades. The response rate is sometimes ignored in the reporting of surveys. It is informative to know the response rate and what accounts for it; the validity and scale of operation are again indicated by such factors. In some studies, e.g. Fishenden (1959) and Auerbach Corporation (1965), the respondents were volunteers or participating as part of an official policy; such respondents might be atypical of the general population of users, or indeed of respondents to mail questionnaires from an outside body.

4.5 Methodology of user studies

There are four basic methods of obtaining data from respondents: personal interview, questionnaire, diary and observation. The advantages and disadvantages have been well documented [Parker & Paisley (1966), Borko (1962), Bourne (1962a)], but the type of method used must be noted in a report of the study, so that the data can be put into perspective. In some cases two methods have been used; this may reduce the disadvantage of one particular method, and may also allow the validity of some results to be checked.

A major difficulty when comparing studies relates to the interpretation and compatibility of survey questions, the incompatible categories and groupings of the data, and the varying methods of presenting the results of the analysis. To facilitate the respondents' interpretation of questions, Auerbach Corporation (1965), Herner (1959) and INFROSS (in some questions) asked respondents to refer to specific incidents, so that it is more easily recognisable when the respondent has not fully understood a question; this technique also allows him to think

positively about his methods of seeking information rather than in the abstract form and provides more reliable results. It may be hazardous to compare data gained in this way with that which is of a more subjective nature. This is illustrated in Table 2 where the respondents in Scott's survey (1959) were asked to recall the most recent article that was of direct use to them and to name the source; from this one article the relative use of information sources was calculated. This method is difficult to equate with that used by the INFROSS survey which asked respondents to assess the usefulness of fifteen named sources on a rating scale of 0-9, which was converted to the categories "often used", "sometimes used", "rarely used" and "not used". Another problem concerned with the interpretation of questions is met when methods of locating references are compared. Some surveys do not indicate whether the respondent has been asked to name the methods used when specifically searching for references, or the method by which he comes across most of his references, whether specifically searching or not.

Incompatible categories and groupings of data cause serious problems, and as can be seen from all the tables there is considerable overlapping or omission of categories. It is essential that each survey adequately defines the categories used to describe data. Another problem that arises from category definition occurs when a list of items is given, and the respondent is asked to show their relative value for him. This is again illustrated in Table 2, when both INFROSS and Herner (1954) give fifteen physical forms of information, but some categories are completely different.

The results of user studies are presented in a variety of ways and comparison of results is therefore impeded. For instance, when methods of locating references are compared, the studies presented in Table 3 show the percentage of respondents who use each method, while studies by Hogg & Smith (1959) and Fishenden (1959) present a relative use of each method by the percentage of articles retrieved through each method. The two methods of presenting data are incompatible and studies cannot be compared. It would be preferable for data to be reported in ways that allow data from different studies to be so calculated that they fit into a standard format. The problem is sometimes due to the fact that published reports are usually a selection from the full results, and comparison may be quite feasible by recalculation of the figures in the

full report. Articles in journals tend to be still more selective, and therefore even less satisfactory for comparison. Where, for valid reasons, published data cannot be presented in a standard and comparable form (at present, there is no accepted form), the raw data should always be available to other researchers on request.

4.6 Statistical techniques

The validity of conclusions drawn from user studies, and from comparisons between studies, depends very much on the statistical techniques used. In most studies reviewed for this report statements of the techniques appear to be lacking. Even if only a brief report is given, a statement indicating the techniques used gives perspective to the study. If a pilot survey was carried out (as is often the case) it is also necessary to report this, as a further indication of the validity of the study.

4.7 Depth of analysis of data

Although science user studies cover many aspects of information needs, when suitable areas of comparison with INFROSS were sought there was in fact a scarcity of data on some areas. INFROSS produced many three-way tabulations which indicated the relationship of all the variables that were considered to be important in influencing information seeking behaviour. Science user studies tend only to produce two-way tabulation; analysis of data in depth is therefore lacking. In the comparison of user studies, only two-way tabulations can be produced because data is not available, or, where it is, it is not comparable.

5.0 Comparison of the information seeking behaviour of scientists and social scientists

Throughout this section the text should be read with close attention to the tables

5.1 Information source

Table 2 shows the type of source from which users gained information. The sources named in each study vary greatly and valid comparison is therefore very difficult. It must be noted that the comparison indicates only how much each source is used relative to other sources, and not the importance of each source; importance must be related to the purpose for which a source is used, and this is not considered here.

Within the formal system, the main information sources for both scientists and social scientists appear to be the monograph and journal literature. Social scientists use both sources to an equal extent [this is shown also by the citation studies of Earle & Vickery (1969)]; but the science user studies show greater emphasis on journal literature. However it is not clear in all studies whether the scientific journal literature is purely scientific in nature or whether it includes trade journals. In Scott's study (1956) the journal literature includes scientific, technical or trade literature; this would explain the very high percentage of his respondents who use it. If academic journal literature only had been included, the percentage would be considerably lower, since the population in Scott's sample was composed of technologists with a wide range of expertise and non-academic qualifications. The Flowers study (1965) indicates that physicists and chemists rely heavily on journal literature, which is in fact their main information source; journals are specifically defined as relating to original published papers, to avoid confusion with other types of journal. 'Trade publications' form a rather loosely defined category which includes publications by particular industries and trades, as well as handbooks (not defined by any user study). They form a particularly important information source for scientists, especially those in applied fields. Herner (1954) shows that 3 per cent of pure scientists and 6 per cent of applied scientists use trade publications as an information source. There is no equivalent information source for social scientists. Theses and patents are not important sources of information

either for scientists as a whole, or for social scientists; patents do not feature as an information source in the INFROSS study. Research reports, which are very numerous in science, tend to be slightly more important for scientists than for social scientists, but there is a disagreement between the Herner (1954) and Flowers (1965) studies; only 1 per cent of respondents in Herner's study, as against 15 per cent in the Flowers study, utilized research reports.

The informal system tends to be regarded as less useful than the formal communication system as a source of information. The Flowers (1965) study indicates that physicists and chemists regard informal personal contacts as more useful than social scientists. Conferences and meetings also are regarded as slightly more useful by scientists than social scientists.

The characteristics of the sciences (section 2.1) suggest that sources dealing with measurement, standards and mathematical tables would be considered important, as is shown in the study by Herner (1954). There are few comparable sources for social scientists. Similarly, the use of government publications by social scientists, which is substantial, would hardly be applicable to science user studies.

The INFROSS study covered new media sources, including such forms as microform and audiovisual media, which could well be used by scientists. Since previous user studies had not considered these, no comparison is possible.

5.2 Retrieval of information

Table 3 shows the relative usefulness of methods of retrieving information. No indication is given of the importance of each method, as this depends on the purpose for which the information is required.

Citations or references gained from a published paper, book or report form an extremely useful method of locating references for both scientists and social scientists. In fact, for the social scientist they form the most heavily used methods if bibliographies in books are also considered with this category. The study by Herner (1954) also indicates

citation as being, along with personal recommendation, the most heavily used method for scientists. The Scott study (1956) however gives a rather lower ranking to the usefulness of citations; this may be due to the fact that the sample was composed of technologists, who require access to specific information rather than to primary literature, and who tend to scan current technical and trade journals.

Both scientists and social scientists tend to find abstracts and indexes a very useful method for locating information, and both appear to use them to a similar extent. The main exceptions to the general pattern within the science user studies are the Scott (1956) and Flowers (1965) studies. That only 4 per cent of Scott's sample used abstracts/indexes may again be accounted for by the fact that they were technologists and would not need to use the formal bibliographic tools giving references to the primary academic-orientated literature. The percentage of respondents in the Flowers study who claimed to use such tools is much higher than in any other study; there is no obvious reason to account for this.

The use of separately published bibliographies is considered fairly important by the social scientists, and by those scientists sampled in the study by Herner (1954). In the other science user studies bibliographies are not usually considered as a separate category; where they are, only a small percentage of respondents find them useful.

Library/information departments tend to be used to a similar extent by both scientists and social scientists, and, when compared with other methods of retrieval, they are not considered particularly useful. This is probably because users regard libraries mainly as sources of supply of information already identified, rather than the means by which information may be identified. The use made of library services is very much related to the quality of service provided, and this may vary from one environment to another. For instance, the provision of information officers is by no means widespread. Moreover the job specification of an information officer in an academic environment may be different from that in an industrial environment. In the former the main task may be to provide references, while an applied scientist needs actual information. This is exemplified by Herner (1958) who found that pharmacologists in a particular company

preferred to do their own correlation and synthesis of material and therefore required references to the literature, while clinicians who were concerned with the action of drugs on patients preferred to receive actual information. The INFROSS finding, that researchers in education were more likely to seek the assistance of library staff than other social science researchers, is probably explained by the special nature of college and school of education libraries. These libraries are small compared with university libraries, and personal contact with the library staff is usually easier to make.

Neither scientists nor social scientists consider reviews particularly useful for locating information. This is surprising, as there are many more reviews in science than in the social sciences; the reviews that do exist in the social sciences tend to be widely scattered in the literature.

Personal recommendation is considered by scientists to be as useful as (Herner 1954, Flowers 1965), or more useful than (Scott 1956, Glass & Norwood 1959), the formal bibliographic tools for locating references. Social scientists consider personal recommendation to be slightly less useful than abstracts/indexes, and of much less importance than citations. The category 'personal recommendation' is very broad and includes all references arising from casual conversation and formal conversations with colleagues within the same establishment and outside it, offprints sent by authors, and correspondence with other workers in the field.

Finding references by chance is a very common way of finding information: Scott (1956) found that 41 per cent of respondents regarded this method as useful; the comparable figures in the Glass & Norwood (1959) study are 33 per cent, and in both the Martyn (1964) and Herner (1954) studies, 17 per cent. The figure given in the table for social scientists refers only to finding references by chance by scanning library shelves. Other methods of discovering information considered by INFROSS which have an accidental element include scanning of periodicals and the stocks in bookshops, receiving offprints, and conversations with colleagues. Both scientists and social scientists find information most frequently in the course of their routine reading.

It appears that a relatively useful method of locating references is by private index (Fishenden 1959, Herner 1959, Martyn 1964) and from recollection of previous reading (Fishenden 1959). Although INFROSS asked about personal files, they were not considered in terms of relative usefulness with other methods of retrieval, and therefore no comparison is possible.

In summary, the most heavily used methods by which scientists gain information are personal recommendation, chance, abstracts/indexes and citations. There is close agreement on the usefulness of these methods in the science user studies; the only discrepancy is in the ranking of them, as will be seen from Table 3. Social scientists regard citations, abstracts/indexes and personal recommendation, in that order, as most useful.

5.3 Use of abstracting journals

It is difficult to make an accurate comparison of the extent of use of abstracting journals, for data from studies is presented in a variety of ways. For instance, INFROSS asked respondents to rate abstracts and indexes according to their usefulness for discovering references to relevant published information for their current research. In contrast to this subjective approach, Hogg & Smith (1959), Herner (1959) and Fishenden (1959) give figures of actual use of abstracting journals. The comparison is made more difficult by the fact that the figures in these studies relate to different time periods, which vary from fourteen days to six months. Despite the limitation of comparison, Table 4 indicates that scientists tend to use abstracting journals less than social scientists. The study by Herner (1959) however, does not support this: the high percentage of respondents who claimed to use abstracting journals within the last six months may have done so only once within that period. Hogg & Smith (1959) postulate that the low usage of abstracting journals may be the result of environmental conditions; few libraries may circulate abstracting journals (keeping them principally for use in the library), or alternatively the institution's library's own weekly bulletin may be found easier to scan for current references, and may be more up-to-date, than abstracting journals. Of the 78 per cent of researchers in the INFROSS sample who judged abstracts to be of some use for discovering

references to relevant published information, a large number used them frequently: 22 per cent judged them of low usefulness, 23 per cent moderately useful, and only 32 per cent judged them to be very useful.

5.4 Function of abstracting journals

Scientists tend to use abstracting journals slightly more for current awareness than for retrospective searching. Only in the Herner (1954) study does the function of retrospective searching appear as more important than current awareness. Social scientists tend to use abstracting journals mainly to keep track of material relevant to their own research, and also for keeping informed about current literature; the use of abstracting journals for comprehensive retrospective searches is relatively rare.

5.5 Attendance at, and value of, conferences/meetings

Similar percentages of scientists and social scientists attend conferences, but the judged value of conferences varies among studies. Within the science user studies, the applied scientists tend to find conferences of less value than pure scientists (Herner 1954). Social scientists tend to value conferences even less, 24 per cent finding them useful, 13 per cent finding them irrelevant, and 63 per cent finding them of peripheral importance.

Conferences may be judged useful for information gained from either (a) papers presented and discussion thereon, or (b) informal personal contact. Of the pure scientists in Herner's (1954) study, the majority stated that most information gained was from informal conversations, though applied scientists gained most information from the papers presented. In the INFROSS survey 29 per cent of respondents gained information mainly from the papers presented, 31 per cent from discussion following the presentation of the papers, and 41 per cent from informal contacts (the categories are not mutually exclusive). It therefore appears that both pure scientists and social scientists value conferences not so much for the papers presented, as for the information gained through personal contact.

5.6 Use of foreign language material

Table 7 shows that the linguistic ability of social scientists is generally less than that of scientists. Of the social scientists, 11 per cent could not read any foreign language at all. The language barrier becomes more serious in the social sciences when it is realised that only 35 per cent of respondents in the INFROSS survey scanned foreign material for their primary research interest.

Wood (1967) found that 77 per cent of scientists had come across a paper in a foreign language that they would have liked to read but could not, because of the language barrier; 3 per cent of these papers were in French, 33 per cent in German, 33 per cent in Russian, 17 per cent in Japanese and 1 per cent in Chinese. Hogg & Smith (1959) found that 4 per cent of scientists made no use of foreign material, but of those, 48 per cent thought German literature would be of potential value, 45 per cent French, 36 per cent Russian, 11 per cent Italian and 10 per cent Japanese. Social scientists do not appear to be aware of the language barrier to the same extent as scientists, for 62 per cent claimed the language barrier did not affect the conduct of their research, 27 per cent claimed that language had a small effect, 8 per cent a moderate effect and only 2 per cent a great effect. Those in the last category claimed it was the Slavonic languages that created most problems. When asked if language had affected the choice of their research, 22 per cent claimed that it had, and 78 per cent that it had not. The reason that social scientists do not have the same language ability as scientists, or indeed are as aware of the problems it creates, may be related to the fact that social science is often concerned with local circumstances dictated by culture that may be of little relevance to nations of differing cultures.

In order to assess the success of methods used to overcome the language barrier, INFROSS considered four main actions, and found that if the original article was easily accessible 15 per cent of respondents obtained translations, 30 per cent tried to get the gist of the article themselves, 27 per cent sought an English abstract or summary and 28 per cent ignored it. If the reference was of particular importance the figures became 60 per cent, 17 per cent, 23 per cent and 1 per cent

respectively. When the original article was not easily accessible, 9 per cent obtained translations, 15 per cent tried to get the gist of the article, 20 per cent sought an abstract and 56 per cent ignored it. Where the reference was considered particularly important, the figures become 43 per cent, 22 per cent, 31 per cent and 4 per cent respectively; ease of access to translation facilities, not surprisingly, dictates the extent to which efforts are directed to overcome the language barrier. Wood (1967) found that when scientists came across foreign language material the most popular method of dealing with it was to seek an English summary. If unsuccessful, they then tried to locate a full translation, or, if none existed, they either ignored the article or attempted to translate it themselves. He also showed that scientists put more effort into obtaining a translation if it could be done within their own institution. Saunders, Pargeter & Hutchins (1971) indicate similar trends in scientists' behaviour towards overcoming the language problem. It therefore appears that there is little difference between scientists' and social scientists' experience of the language barrier, despite the fact that scientists are more aware of its existence, and have rather more liguistic competence.

5.7 Use of library services

Libraries and information departments tend to be used most for obtaining named material on request. Hogg & Smith (1959) show that of the literature read by scientists within the fourteen day diary period, 52 per cent was obtained from the library. In the study by Martyn (1964), 89 per cent of the total sample used the library for obtaining material. The Flowers study (1965) showed that 26 to 35 per cent of respondents used the library/information department as a general source of information, while in the Scott (1956) study fewer than 50 per cent of researchers in firms which had their own library used it. Herner (1954) found that 42 per cent of respondents obtained their published materials primarily from technical libraries, 9 per cent depended mainly on personal collections and 49 per cent used both libraries and personal collections. Pure scientists tended to use libraries more than applied scientists (64 per cent and 42 per cent respectively). 33 per cent of the INFROSS sample considered that their local library satisfied most of their demands for research, while 36 per cent considered it satisfied some of their demands, and 24 per cent a few of their demands.

For the purposes of retrieval - that is, finding relevant references, rather than locating them when identified - library services are much less valuable; this is clearly brought out in Table 3, where methods of locating references are compared. Only 18 per cent of the INFROSS sample used their own institution's library for locating references for research, while 16 per cent used libraries outside their own institution.

5.8 Delegation of searching

Literature searching is not adequately defined by user studies; it may indicate a review of the literature within a particular field, or merely following up several references that appear relevant. Only in Martyn's study (1964), which specifically investigated literature searching habits, are the length and depth of search, and the confidence of researchers having tapped all relevant information, taken into account.

It is therefore feasible only to compare delegation of searching, and, as can be seen in Table 8, the percentage of scientists and social scientists that never conduct their own search is similar. However there are considerable differences in the degree of delegation of searching; a much higher percentage of social scientists conduct their own search than scientists. This is probably due almost entirely to the fact that many more scientists, particularly in industry, have access to information services of this kind than social scientists, most of whom are in universities or research institutes.

The reasons scientists and social scientists give for always conducting their own search tend to be similar. Hogg & Smith (1959) found 47 per cent were critical of the library's competence, 2 per cent did not know of the library service, and 50 per cent used their own personal indexes and preferred to do it themselves (no particular reason stated). INFROSS found that 37 per cent of respondents did not consider anyone else competent to perform a search, 35 per cent found it was difficult to verbalize their real needs, 14 per cent mentioned the loss of browsing, and 9 per cent considered delegation merely unnecessary (6 per cent - all research students - stated that it was not permitted under degree regulations).

5.9 Late detection of information

Science user studies show considerable differences in the percentage of respondents who experience late detection of information. Comparison with INFROSS is hazardous, for although only 7 per cent of social scientists sampled 'frequently' found information late, 68 per cent 'occasionally' did. It is difficult to relate the degrees of frequency of late detection in the INFROSS sample to the science user studies, which do not indicate frequency. Generally it is probable that the users who are most likely to detect late information are those who are most conscientious in their literature searching; those who do not use information sources and services so frequently would not experience so many instances of late detection of information (but on the other hand, their haphazard searching practices might result in accidental late discovery).

5.10 Stimulus for research/ideas

One function of information is as a stimulus for ideas and for research being conducted by the user. There is little difference between scientists and social scientists in this regard. The three most important sources of stimulus are written material, own work and informal personal contact; conferences and meetings are of little stimulus value. Observation/experiment is particularly valuable for scientists, and although INFROSS did not include this category in the question, it is no doubt of some value to social scientists. Minor stimuli include teaching, trade exhibitions, courses, etc., but these play a very small part for both scientists and social scientists.

5.11 Generalized profile of the scientist's and social scientist's information seeking behaviour

To help summarize the comparison of results of science user studies and social science user studies a generalized profile of the information seeking behaviour of the two types of scientist has been constructed. It must be noted that it is based on comparisons that are of very uncertain validity, and therefore the profiles must be considered to indicate only broad trends.

	Scientist	Social Scientist
Information source	Makes little use of monograph literature. Most useful source are journals plus trade publications handbooks etc. Conferences are of little value but informal personal contact is valuable.	Uses monographs plus journals to a great extent. Conferences are of little value but informal personal contact is valuable.
Methods for locating references	In rank order: personal recommendation, chance and abstracts/indexes are the most used methods. The use of library/information service is not important.	In rank order: citation abstract/indexes and personal recommendation are most used methods. The use of library/information department is not important.
Use and function of abstracting journals	Scientists used abstracts slightly less than social scientists, but both used them to the same extent for current awareness and retrospective searching.	
Attendance and value of conferences	Both attend conferences to a similar extent Pure scientists gained information from social contacts, applied scientists gain information from the papers presented.	Information gained mainly through social contacts and papers presented.
Foreign language capability	Linguistic ability of scientists and awareness of the language barrier is greater than that of social scientists.	

/cont .....

	Scientist	Social Scientist
Use of library	*Both use libraries to a similar extent for requested* material. Both make little use of libraries for seeking relevant references.	
Delegation of literature searching	Tend to delegate searching.	Tend to conduct own search.
Late detection of information	Both experience instances of late detection to a similar extent.	
Stimulus for research/ideas	Written material, own work and informal personal contact are important for both scientists and social scientists.	

6 0 Conclusion

a) This paper aimed to discover points of comparison between INFROSS and science user studies. From the generalized profile of scientists' and social scientists' information seeking behaviour, it can be seen that only broad trends can be discerned. In many cases the range tends to be so wide that the social scientist can be accommodated by it, and only in a few cases do obvious discrepancies in behaviour occur. In user studies points of comparison are extremely tenuous due to the inadequacies in concept, conduct, analysis and reporting of many user studies.

b) A major factor mitigating against the building up of a profile of a 'typical' scientist is that there are differences in the information seeking behaviour of scientists in different disciplines. Physical scientists, biological scientists and engineers all show varying methods of seeking information, and when a generalized profile is drawn the most interesting points of their information seeking behaviour are lost. The differences between scientists' and technologists' use of information are basically related to the fact that technologists are concerned with design and development while the scientist is concerned primarily with investigating scientific phenomena. Scott (1956) found that when technologists were confronted with a problem, 75 per cent preferred to consult a colleague first, rather than the literature, and 61 per cent never obtained any useful information from a professional journal. When technologists do consult the literature it tends to be a trade publication rather than a primary journal. Allen (1968) also notes that the literature references of technologists tended to be trade publications or technical magazines. This may be due to the fact that engineering journals reporting research are orientated towards the academic engineer rather than the working engineer. Rosenbloom & Wolek (1967) showed that engineers gain most of their information (63 per cent) from in-house sources, especially co-workers, while scientists look outside their own institution for most of their information (67 per cent). These facts suggest that information systems should be designed to accommodate different task requirements, for although each system has the same structure, that is

all scientists use the same information sources and the same methods of retrieval, and have similar problems with the language barrier, etc., the degree of use and the scale of problem created vary, and account for differences in the information seeking behaviour of scientists.

c) Information requirements vary according to job function: the validity of comparing studies of populations in pure and applied fields is questionable. The INFROSS population is composed mainly of academic researchers, while the populations of many science user studies include technologists and scientists employed in a variety of environments (not necessarily all engaged in research). Researchers within an industrial environment may be affected in the nature and conduct of their research by tight profit margins to which the firm must adhere. If a comparison of INFROSS with only those scientists employed in academic research were feasible, it might reduce the problem of differing populations. However, there are few studies dealing specifically with scientists in academic research that are suitable for comparison with INFROSS; one of the few is the study by Menzel (1958) of academic scientists, but very little data can be derived from it for comparative purposes, because the emphasis was on areas different from those looked at by INFROSS.

d) The present paper confirms Paisley's criticism on the state of user studies. Meaningful patterns and linkages cannot develop from studies performed in such isolated and varying conditions. The lack of unifying theory may partly account for the lack of implementation of the results of user studies. Although there are numerous user studies, very little, if anything, is heard of the utilisation of results for the design of a better system.

e) To break this vicious circle of the idiosyncratic user being the subject of idiosyncratic studies, efforts must be directed towards more unified studies that correlate more meaningfully. Most user studies have been conducted to increase the understanding of a particular local situation, or help solve a particular problem. One cannot reasonably expect such studies to be capable of wider application, or necessarily to

be comparable with other studies. The problem concerning large scale studies is not so much that designers of the studies have not wished to make them comparable, as that there is as yet no standard methodology which is generally accepted. Each investigator of a study believes that it can and often does improve on previous studies. This is as true of INFROSS as of science user studies. It is not until there is an acceptable method of user investigation which can be standardized that one can hope for results of studies that are capable of comparison and accumulation to form a genuine body of knowledge.

f) The problems arising from the fragmentary approach of science user studies have been well illustrated; it is hoped that in INFROSS, at least, such problems have been minimized by the very wide and comprehensive approach to the social sciences.

Table 1

Summary of selected user studies

ER STUDY	OBJECTIVES OF STUDY	METHODOLOGY	POPULATION	NO. OF RESPONDENTS	SAMPLE SELECTION	RESPONSE RATE	SPECIAL TECHNIQUES
rner 54	To analyse information-gathering methods of scientific personnel in Johns Hopkins University	Interview	Pure & applied scientists	606	A cross-section of typical fields of scientific personnel	Not stated	None
ott 56	A general enquiry carried out in the UK for the Dept. of Scientific & Industrial Research to examine the role of scientific information in the work of the scientist and technologist	Interview-1 hour	Technologists in the British electrical and electronics industry	1,082	Random	Not stated	Factor analysis
nzel 58	An exploratory study to distinguish scientists' information needs, the means and occasions of scientific-information exchange and the conditions (e.g. type of institution) that influence his information-seeking behaviour	Interview	28 biochemists, 28 chemists, 21 zoologists at a prominent American university	77	Not stated	Not stated	None
shenden 59	To improve efficiency of information retrieval at Atomic Energy Research Establishment, Harwell	Interview Diary - 2 month	Scientific and technical staff with honours degrees	113 (63 diary, 50 interview)	Cross-section of volunteers	N/A	None
ass & rwood 59	A pilot study to examine ways scientists learn of scientific work that is important to their own research	Interview	A variety of fields but mainly concentrated in the biological sciences	50	Not stated	Not stated	None

/cont .....

SER STUDY	OBJECTIVES OF STUDY	METHODOLOGY	POPULATION	NO. OF RESPONDENTS	SAMPLE SELECTION	RESPONSE RATE	SPECIAL TECHNIQUE
erner 959	To study the use American medical scientists make of information in general, foreign language information & Soviet information, in particular	Interview - 1¼ hours	Scientists in 59 medical research organisations in 6 cities. 45% had M.D. degrees, 45% Ph.D or D.Sc degrees	500	Random sample	Not stated	Critical incident approach
ogg & mith 959	To discover how personnel at U.K.A.E.A. sought and used information	Interview - 45 mins. Diary - 14 days	Applied scientists & technologists in Research & Development branch who work at 5 laboratories & at the Group's headquarters	157	Random selection within 3 status grades	Nearly all respondents	None
artyn 964	To investigate literature searching by research scientists	Questionnaire	Research chemists in industry, academic research scientists, scientists in Government research laboratories	817 for 1st 647 for 2nd	Random sample	83% for 1st, 88% for 2nd	None
uerbach orporation 965	To determine how personnel in the RDT&E of the Department of Defence acquire & utilize technical & scientific information in the performance of their tasks	Interview - 2 hours	13% concerned with research, 50% developments & 26% R&D support	1,375	Random sample	N/A	Critical incident approach
lowers 965	To increase the efficiency of information retrieval in scientific research	Questionnaire	Physicists (1,007)& chemists (2,014)	3,021	Random sample	49.5%	None
rquhart 965	To investigate the sources of references to publications requested from the NLL	Questionnaire	Physicists	1,007	Not stated		None

/cont .....

UDY	OBJECTIVES OF STUDY	METHODOLOGY	POPULATION	NO. OF RESPONDENTS	SAMPLE SELECTION	RESPONSE RATE	SPECIAL TECHNIQUES
	To study the amount and value of foreign scientific literature and the linguistic ability of readers at the NLL	Questionnaire	Scientists Librarians (not included in this comparison)	2,355	Random	just under 50%	None
s, r & s	To study the place of foreign language material in the research activity of an academic community	Interviews - 30 mins	Engineers, material technologists, pure scientists, medicine and dentistry scientists	632	Not stated	Not stated	None
	To investigate the information requirements of social scientists in the UK	Questionnaire Interview Observation	Academic researchers. Researchers in government departments. Social workers. College of education lecturers. Schoolteachers	1,089	Random sample of those in the major environments, & selected individuals who could be traced in other environments	41.8%	Some use of critical incident approach

Table 2

Information source

Percentage of respondents

	Flowers[a]	Herner 54[d]	Scott[h]	INFROSS[l]
Monograph	-	12	4[i]	17
Journal	38[b]	11	73[j]	17
Trade publication	22[c]	16[e]	-	-
Theses	-	4	-	3
Research report	1	15[f]	-	8
Patent	1	1	-	-
Informal contact	31	-	-	8[m]
Formal contact (conferences/meetings)	7	-	-	2
Other	-	41[g]	23[k]	45[n]
Total	100	100	100	100

Flowers 1965

a. Relates to sources of information found most useful for specific information

b. Relates to original published papers

c. Relates to handbooks

Herner 1954

d. Relates to type of publication used to obtain information. The figures are the sum of both pure and applied scientists

e. Includes handbook 11%

f. Includes unclassified research reports 8%, and classified research reports 7%

g. Relates to use of elementary textbooks 7%, encyclopedias 2%, dictionaries and glossaries 6%, mathematical and physical tables 9%, standards specifications and test codes 4%, and supply catalogues 6%

Scott 1956

h. Respondents were asked to recall the most recent article that was of direct use to them and to name the source

i. Relates to books and handbooks

j. Scientific, technical or trade journal

k. Includes advertisements 11%, leaflets 5%, newspapers 4%, abstracts and digests 2%, reprints, offprints 1%

INFROSS 1971

l. Respondents were asked to rate 15 physical forms according to usefulness for their current research. The figures tabulated relate to the "often" used category as opposed to the "not used", "rarely used" and "sometimes used" categories. (Categories were produced by collapsing rating scales)

m. Includes contact with colleagues within own institutions 4%, and with academics elsewhere 4%

n. Includes collections 10%, newspapers 5%, government publications 10%, maps 3%, recorded sound 1%, computers 6%, manuscripts/archives 3%, other physical 4%, other non-physical 1%

Table 3

Most effective retrieval methods

Percentage of respondents using each method

	Scott[a]	Flowers[f]	Herner[i] 54	Fish-enden[l]	Herner[o] 59	Martyn[q]	Glass & Norwood[v]	INFROSS[A]
Citation	5	10[g]	19	-	13	19	6.9	30[B]
Abstract/ index	4	40	15	23	12	13	6.4	18
Bibliography	-	-	14	3	6	4	1.7[w]	12
Library catalogue	18[b]	10[h]	8	12[m]	9	4[r]	-	8[C]
Reviews	-	10	8	-	9	-	4	10
Personal recommendation	30[c]	30	19[j]	-	11	28[s]	32.7[x]	14[D]
Chance	41[d]	-	17[k]	-	12	17[t]	33[y]	8[E]
Other	2[e]	-	-	62[n]	28[p]	14[u]	9[z]	-
Total	100	100	100	100	100	100	100	100

Scott 1956

a. Respondents were asked to recall the most recent article they had used and state what the source of the article was

b. Relates to literature searching and includes use of library catalogue, bibliography, abstract/index etc.

c. Includes colleagues within the establishment 19%, outside the establishment 8%, and persons unspecified 3%

d. In the course of routine reading

e. Mass-media

Flowers 1965

f. Respondents were asked to select their first, second, and third methods they usually use for information retrieval

g. Relates to published papers

h. Relates to librarian/information department

Herner 1954

i. The percentages are the sum of both pure and applied scientists

j. Book reviews and publishers' announcements

k. In the course of routine reading

Fishenden 1959

l. Respondents were asked to record the number of useful reports, reviews, books etc. read during a two-month diary period which were found through each source. The most effective retrieval methods are recorded in the table

m. Relates to use of library index and the library staff finding the relevant information

r. Private index 19%, previous use 43%

Herner 1959

o. Respondents were asked to state from a given list of bibliographic tools the methods they had used in the previous six months to locate information

p. Includes personal reference file 11%, publishers' advertisements 9%, library acquisition lists 8%

Martyn 1964

q. Respondents were asked to indicate from a given list which methods they used to locate information for their current research project

r. Relates to use of a library card index 2% and asking a librarian or information officer for references 2%

s. Relates to gaining references from conversation with other workers in the field 15%, from correspondence with other workers in the field 7% and trying to obtain unpublished or not-yet published material from other workers 6%

t. Relates to "keeping up" by reading current publications

u. Use of a personal index or other personal record of scientific or technical data 11% and consultation of reports issued by own organisation for internal circulation 3%

Glass & Norwood 1959

v. Methods whereby scientists actually learned of work crucial to their own

w. Relates to a bibliography or material supplied in a course

x. Relates to casual conversation 22.6%, colleagues within the same department or laboratory 4.3%, from a reprint sent by the author 5.8%

y. Relates to journals regularly scanned 22%, journals regularly subscribed to 8.4%, plus chance 2.6%

z. Relates to book list 0.9%, formal discussion group 1.2%, formal report at a meeting 2.6%, reference work 4.3%

INFROSS 1971

A. Respondents were asked to rate 12 given methods of locating references to published material, according to their usefulness for their current research The figures shown in the table refer to the "often" used category as opposed to the "not used", "rarely used" and "occasionally used" categories

B. Relates to bibliographies or references in books and journals

C. Relates to use of library catalogue 5% and librarian 3%

D. Relates to colleagues within own institution 5%, with persons elsewhere 4% and with experts 5%

E. Relates to scanning own institution's library shelves 4% and other library shelves 4%

Table 4

Use of abstracting journals

	Percentage of respondents
Flowers	46-55[a]
Urquhart	38[b]
Hogg & Smith	32[c]
Fishenden	32[d]
Scott	31[e]
Herner 1959	95[f]
INFROSS	100[g]

Flowers 1965

a. For current awareness and specific information

Urquhart 1965

b. Of those scientists who made a request 38% of them found the reference in an abstracting journal

Hogg & Smith 1959

c. Relates to those who consulted abstracting journals within the 14-day diary period

Fishenden 1959

d. Relates to the diary keepers who made positive use of Nuclear Science Abstracts. 17% used Chemical Abstracts, 17% used Physics Abstracts and 17% used other abstracting journals

Scott 1956

e. Relates to those respondents who knew of any abstracting journal within their field and who made use of them. Of these 21% were able to give at least one identifiable title of an abstracting periodical which they had used in the last three months

Herner 1959

f. Relates to those who have used abstracting or indexing journals to locate published and other sources of information within the last six months

INFROSS 1971

g. Although 100% of respondents claimed to use abstracting journals for discovering references to relevant published information, 22% found abstracting journals not useful. It could be supposed that only 78% used abstracting journals, as presumably if a journal was found not useful it would not be turned to again for locating references. No time limit was implied in the question (no. 20)

Table 5

Function of abstracting journals

Percentage of respondents

	Hogg & Smith[a]	Fishenden[b]	Herner 54[d]	Scott	Flowers[e]	INFROSS
Current awareness	64	52[c]	45	43	30	40[f]
Retrospective searching	36	48	55	21	30	-
Both equally	-	-	-	34	40	-
Total	100	100	100	100	100	

Hogg & Smith 1959

a. Percentage of abstract reading in 14 day diary period

Fishenden 1959

b. Relates to percentage of useful publications read during the 2 month diary period which had been found through abstracting journals

c. Relates to background reading

Herner 1954

d. Relates to significant use made of indexing and abstracting publications

Flowers 1965

e. Relates to the Research & Development group only

INFROSS 1971

f. Relates to respondents who mentioned abstracting journals and periodicals as a means of keeping informed about current literature

Table 6

Attendance at, and value of, conferences/meetings

Percentage of respondents

	Herner 1954		Scott[c]	INFROSS[f]
	pure scientist[a]	applied scientist[b]		
Attendance	67	55	40[d]	69
Usefulness	60	44	68[e]	24[g]

Herner 1954

a. 83% of pure scientists were members of the major societies in their fields. Questions of attendance and usefulness of conferences/meetings were only directed at these

b. 70% of applied scientists were members of the major societies in their fields

Scott 1956

c. Respondents were asked if they had attended any technical or scientific society meeting

d. Relates to the mean of the sample. Of those with academic or technical qualifications 62% attended conferences/meetings while 25% attended of those without formal qualifications

e. Relates to mean of sample. In the research group 62% found conferences useful and 86% in the management and production supervision group

INFROSS 1971

f. Respondents were asked to record any conferences they had attended in the last 12 months

g. Relates to those who found the conference of central importance to their work. 63% found conferences of peripheral importance and 13% found them irrelevant

Table 7

Linguistic ability

	Wood[a]	Hutchins, Pargeter & Saunders[c]	INFROSS[d]
French	92	85	75
German	67	56	27
Russian	10	8	4
Other	18[b]	-	34[e]

Wood 1967

a. Scientists were asked to indicate their degree of proficiency in various foreign languages. The figures in the table relate to those who are capable of dealing with literature in that language and does not imply fluency in the language

b. Relates to 0.3% Japanese, 0.2% Chinese, 17.6% other languages not specified

Hutchins, Pargeter & Saunders 1971

c. Relates to the total ability of all scientists interviewed and includes those that are fluent, those that occasionally use a dictionary and those that frequently use a dictionary. 15.7% of scientists are fluent in French, 4% in German and 0.1% in Russian

INFROSS 1971

d. Relates to languages read

e. Includes other Germanic languages 6%, other Romance 19%, other Slavonic 2% and others not specified 7%

Table 8

Delegation of searching

Percentage of respondents

	Hogg & Smith[a]	INFROSS
Conducted own search	24	72
Never did own search	8	7[b]
Sometimes did own search	66	21

Hogg & Smith 1959

a. 1% of the sample did not do searches

INFROSS 1971

b. Relates to those who delegatedtheir searching extensively

Table 9

Late detection of information

Percentage of respondents

	Flowers	Auerbach Corporation	Menzel[c]	Martyn[f]	INFROSS[g]
Late detection of information	28[a]	13[b]	13[d] 10[e]	22.3	7

Flowers 1963

a. Research delay due to ignorance of previous or current research

Auerbach Corporation 1965

b. Relates to those who after completion of a stated task found information that would have been useful (D.O.D. user study Phase I)

Menzel 1958

c. Percentage of scientists who were able to recall a recent instance of late detection of information that would have made a difference to their work.

d. published material

e. unpublished material

Martyn 1964

f. Relates to those scientists who found relevant information in the literature too late for the information to have full value

INFROSS 1971

g. Respondents were asked to specify whether they had 'never', 'sometimes' or 'often' come across information too late to be used. The figure tabulated refers to the last category. 25% of respondents never found information too late and 68% sometimes did

Table 10

Stimulus for research/ideas

	Scott[a]	Herner 59[e]	INFROSS[j]
Written material of any kind	33	21[f]	30[k]
Own work	23[b]	28	39[l]
Personal contacts (informal)	19	17[g]	18[m]
Conferences, meetings (formal contact)	5	5	4
Requirements of job, or of customer	1	8[h]	-
Observation/experiment	13[c]	9	-
Don't know	1	-	-
Other	5[d]	12[i]	9[n]
Total	100	100	100

Scott 1956

a. From a given list respondents were asked to indicate by what means they got most of their ideas or stimulation for new ideas on improvements or new methods

b. Relates to intuition, thought - no external source admitted to

c. Includes observation on other firms' products, processes etc.

d. Includes trade exhibitions 2%, unclassifiable answers 3%

Herner 1959

e. Respondents were asked to recall where they got the idea (or inspiration) for their present or most recent project

f. Includes reading literature 14%, omissions in the literature 5%, disagreement with literature 2%

g. Relates to colleagues

h. Assignments or suggestions from superiors

i. Includes teaching activities 2%, taking courses 1%, manufacturers or suppliers 1%, miscellaneous 8%

INFROSS 1971

j. Respondents were asked to rate five given sources according to their value as a stimulus of new ideas for their current research. The answers were classified not important, of little importance, of moderate importance and very important. Only the figures related to the latter category are shown in the table

k. Relates to reading

l. Relates to past and current research

m. Relates to colleagues

n. Relates to teaching

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*Actually carried out by the Advisory Council on Scientific Policy, whose chairman was Flowers, but referred to under his name for convenience.

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